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JANUARY 1991

Ontario
Environment
Environnement

ISBN 0-7729-7844-1

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PIBS 1400
log 89-2231-238

Background

At the request of the Ministry's Welland Office, West Central Region, the Phytotoxicology Section conducted a visual surveillance of vegetation in and around the Glenridge Landfill site in St. Catharines for evidence of leachate or leachate gas-induced injury.

The landfill site is located in a former quarry consisting of fractured limestone atop the brow of the Niagara Escarpment. Active since 1976, the landfill operation is currently operating in the south end of the quarry site - immediately north of St. David's Road (Figure 1).

As part of the program to prepare the quarry as a landfill site, a leachate collection system was established on a base of compacted clay. The quarry leachate system was then connected to the city sanitary sewer system. Originally, the landfill leachates were directed into an existing sanitary sewer line at the top of the escarpment which followed a route down the hill along Glenridge Avenue and turned abruptly to the east at Woodside Drive.

Under this arrangement, a heavy rainfall would increase the flow rate from the leachate collection system and create a surcharge in the sanitary sewer line at the base of the escarpment. As a result of the surcharge, heavy metal manhole covers were dislodged and flooding occurred. In 1987, the surcharging resulted in some basements being flooded with leachates and sewage. Photographs of the flooding taken by one resident show a great deal of foam material associated with the liquid. Because the residents are aware of the fact that the landfill leachate collection network is connected to the city's sanitary sewer system, they are fearful of the potential effects the leachate and leachate gases may have on their health.

In an effort of prevent further flooding and gas problems, the city constructed a dedicated sanitary line to carry leachates from the top of the escarpment to a connection on Glendale Avenue. This new line, which became operational in August of 1988, was also equipped with a sodium hypochloride drip system to control odour problems and a vent pipe to collect and dispose of gases. This dedicated line appears to have solved the surcharging problem as there have been no floods or reports of odours.

One storm sewer associated with the quarry site is not connected to the city sewer system, but emerges as an open pipe part way down the escarpment. This system was initially installed by former quarry operators to drain ground and surface waters from the site. At present, water flowing from this pipe flows along a surface route down the face of the escarpment, through two residential properties and drains into a large screened storm drain receptacle on Leawood Court (Figure 1).

Citizen Complaints

During the initial visit to Glenridge landfill site and surrounding area on August 17, 1989, Welland office representatives directed Phytotoxicology investigators to the properties of several residents located just below the escarpment.

At one location (site 5) at the corner of Glenridge Avenue and Trillium Lane, the resident advised that after the Glenridge Landfill site became operational and was connected to the city's sanitary sewer system, mixtures of rain water and leachates from the landfill site have caused basement flooding and the eruption of 2 manholes (one buried under several feet of earth) on a number of occasions. No similar events occurred before the landfill site existed or since the dedicated line was installed.

At a second location (site 6), water from the open pipe described earlier, was observed flowing through the residential property and into a large screened storm drain, also located on the property. After the landfill site started operations, the residents indicated that the appearance and odour of the stream liquid was altered and that the stream became stained with an orange-red residue.

Although flooding had not occured at a third property on Woodside Drive, 'chemical-smelling' fumes were a constant concern, particularly since some members of the family had experienced sudden and unusual health problems.

Complaint investigations were conducted at all three residential properties by Phytotoxicology investigators and the findings will be reported separately.

Glenridge Landfill Site Area - Visual Examination of Vegetation

During the weeks of August 14 and 21, 1989 the Ministry of the Environment dispatched the MAMU #1 mobile air monitoring unit to the area to investigate gaseous emissions suspected to be orginating from the Glenridge Landfill site. Test results indicated that no concentrations of volatile organic compounds or common contaminants detected at any of the test sites approached or exceeded applicable Ministry Air Quality Criteria, Guidelines or Standards. At one site (A162) the monitoring crew observed that some leachate appeared to be entering a small stream but that the constituents appeared to be only low-boiling aliphatics. (Results of the 1989 St. Catharines/Thorold Air Quality Surveys (Glenridge Landfill and Exolon Limited), Technical Memorandum, Ministry of the Environment, Air Resources Branch, ARSP Section, January 31, 1990.)

It was deemed appropriate that the Phytotoxicolgy vegetation survey include those sites monitored by the MAMU. Visual observations were conducted on September 12 by Mr. G. Vasiloff of the Phytotoxicology Section. All sites visited in the area are shown in Figure 1. Sites common to MAMU and Phytotoxicology vegetation surveys have been identified in the figure. Where possible, remaining Phyto survey sites were established near sanitary sewer manholes/grates. Observations for air pollution foliar symptomatology were made on a wide range of indigenous vegetation species at each of the Phytotoxicology survey sites. These observations have been itemized in Table 1.

As the table shows, some vegetation at only 2 of the 11 Phytotoxicology sites exhibited foliar injury characteristics which may have been caused by unidentifiable pollutants and not by insects or disease agents. It cannot, however, be concluded that the injury symptoms were induced by the effects of leachates or leachate gases although either could be suspected by association. Of all survey sites, only these two (sites 4 and 6) are located adjacent to the liquid flowing from the open pipe on the escarpment.

None of the other vegetation at any of the remaining 9 sites exhibited injury which was similar or which could be attributed to air or soil pollutants. Herbarium samples of the injured vegetation were collected and photographs taken for documentation purposes.

The foliar injury symptoms observed at sites 4 and 6 appear to be similar to those found by researchers working with leachates at the University of Guelph. They found that foliage of plants whose roots were irrigated with leachates developed similar terminal and marginal necrosis along with intercostal chlorosis. Because leachates generally contain heavy loadings of solutes, a depressed osmotic potential prevents the absorption of leachates or moisture into plant roots. As a consequence of the osmotic situation, no moisture from the root area is available to the plants creating 'drought-like' symptoms in the foliage.

Vegetation and soils on the property at Glenridge Road and Trillium Lane (site 5) had been flooded repeatedly by the eruption of two adjacent manholes and yet the foliage appeared healthy and free of pollutant-related injury symptoms. Whatever leachates were contained in the flood water may have been sufficiently diluted to prevent the 'drought-like' symptoms observed at sites 4 and 6. Vegetation at other sites located near sanitary sewer manholes/grates appeared to be injury-free (sites 2, 5, 6 and 7). Apart from insect and disease symptoms and dust on the foliage, vegetation at the two sites within the quarry appeared relatively healthy and vigorous.

Conclusions

Suspected pollution injury symptoms were noted on some vegetation at 2 survey sites where it is suspected that leachate may be present in the surface waters. It cannot be stated with any certainty, however, that the injury symptoms observed were induced as a result of exposure to leachates or the leachate gases. Air monitoring tests indicated that no concentrations of volatile organic compounds or common contaminants exceeded applicable Ministry Standards, Criteria or Guidelines.

No pollution-type visible injury symptoms were observed on vegetation on properties which had experienced repeated flooding or which were located near sanitary sewer manholes or grates.

Results of inorganic and organic analyses conducted on soil samples collected in 1989 and 1990 from complainants' and other properties, will be reported separately.

TABLE: 1 **Visual Observations of Vegetation Foliage at 11 Sites in the Vicinity of the Glenridge Landfill Site, St. Catharines**

September 12, 1989

Site Number	Vegetation Examined	Site Location/ Visual Observations
1		Located within landfill site - north of actual filling area - adjacent to white plywood structure.
	Manitoba maple	No visible injury
	sumac	Evidence of insect injury.
	hawthorn	Evidence of insect and disease injury
	cherry	Evidence of insect injury.
	poplar	Evidence of disease injury.
2		MAMU **site** - Located within landfill site - north of actual filling area - adjacent to very old manhole.
	Manitoba maple	No visible injury - foliage heavily covered with road dust
	mountain ash	Leaf miner insect injury - foliage heavily covered with road dust.
	sumac	Terminal necrosis - senescence Foliage heavily covered with road dust.
	poplar	11-35% terminal and marginal necrosis possibly drought or senescence Foliage heavily covered with road dust.
	peach	Insect injury only. Foliage heavily covered with road dust.

TABLE: 1 (cont'd)

Site Number	Vegetation Examined	Site Location/ Visual Observations
3		**MAMU site** - Rear property of Niagara Peninsula Children's Centre, Glenridge Avenue.
	Manitoba maple	Evidence of insect injury and senescence.
	sumac	Evidence of insect and disease injury
	elm	Evidence of leaf miner insect injury.
	wild grape	Evidence of insect injury.
	poplar	Evidence of insect and disease injury
	wild apple	Evidence of insect and disease injury
	green ash	Evidence of insect and disease injury
	wild cherry	Evidence of insect injury.
	hawthorn	Evidence of insect and disease injury
	oak	Evidence of insect injury.
4		**MAMU site** - Part way down escarpment on west side of Glenridge Avenue. Site where open pipe drains leachate from Glenridge Landfill site onto property near 450 Glenridge Ave. A foul pungent odour discernable from open end of pipe. Flow rate estimated at 20 L/min.
	sugar maple	**Terminal and marginal necrosis on abnormally small lower leaves - dead branches visible in lower crown. Foliage in upper crown - normal size with fewer injury symptoms.**
	ironwood	Some terminal necrosis - source of injury unknown.

TABLE: 1 (cont'd)

Site Number	Vegetation Examined	Site Locations/ Visual Observations
4		Located immediately above storm drain pipe.
	elm	Small tree, essentially dead - 2-10% terminal and marginal necrosis on foliage of bottom shoot.
	basswood	Located immediately above storm drain pipe - 2-10% terminal and marginal necrosis plus intercostal chlorosis. Evidence of insect chewing injury.
	Manitoba maple	East side of Glenridge Avenue. No visible injury.
	wild grape	Evidence of insect chewing injury.
5		MAMU site - Corner of Glenridge Avenue and Trillium Lane and along Trillium Lane.
	oak	Severe insect chew and evidence of powdery mildew.
	cherry	No visible injury
	lilac	Evidence of insect chewing injury.
	sugar maple	Evidence of insect chewing injury. Traces of light tan terminal necrosis.
	silver maple	No visible injury.
	mountain ash	No visible injury.
	green ash	Evidence of insect activity.
	rose of Sharon	Evidence of disease injury.

TABLE: 1 (cont'd)

Site Number	Vegetation Examined	Site Location/ Visual Observations
6		MAMU site - Leawood Court.
	sugar maple	Located beside open creek near storm sewer grate. **2-10% terminal and marginal necrosis plus intercostal chlorosis on stunted lower crown foliage**
	white ash	**Abnormal growth on some compound leaves - normal terminal leaf accompanied by very tiny lower leaves.**
	forsythia	Near storm sewer grate. No visible injury
	forsythia	Below storm sewer grate. Evidence of terminal discolouration - may be incipient senescence.
	sugar maple	Behind residence - part way up escarpment beside open stream. **2-10% terminal, marginal and inter-costal necrosis and chlorosis.**
	Manitoba maple	Above waterfall at rear of property. Evidence of insect leaf miner injury.
	weeping willow	Above rear dam. Evidence of insect injury.
7		Located at the corner of Victor St. and Glenridge Avenue - near manhole.
	catalpa	Sooty mold on all leaves.
	silver maple	No visible foliar injury.
	tulip tree	No visible foliar injury.

TABLE: 1 (cont'd)

Site Number	Vegetation Examined	Site Location/ Visual Observations
7	basswood	Evidence of insect chewing injury.
	rose of Sharon	No visible injury.
	horse chestnut	Evidence of disease injury.
	forsythia	Dead top - may be salt injury.
	weed varieties	No visible injury.
8		Near Barbian Trail.
	basswood	Evidence of insect chewing injury.
	wild grape	Evidence of insect chewing injury.
	cherry	Evidence of insect chewing injury.
	hawthorn	Evidence of disease injury. Evidence of terminal and marginal necrosis - senescence suspected.
	black walnut	Evidence of intercostal and marginal fungal spotting.
	little leaf Linden	No visible injury.
9		Vacant lot on Circle Heights
	wild grape	Evidence of insect chewing injury.
	sumac	No visible injury.
	rose of Sharon	No visible injury.
	ash	Evidence of intercostal fungal injury

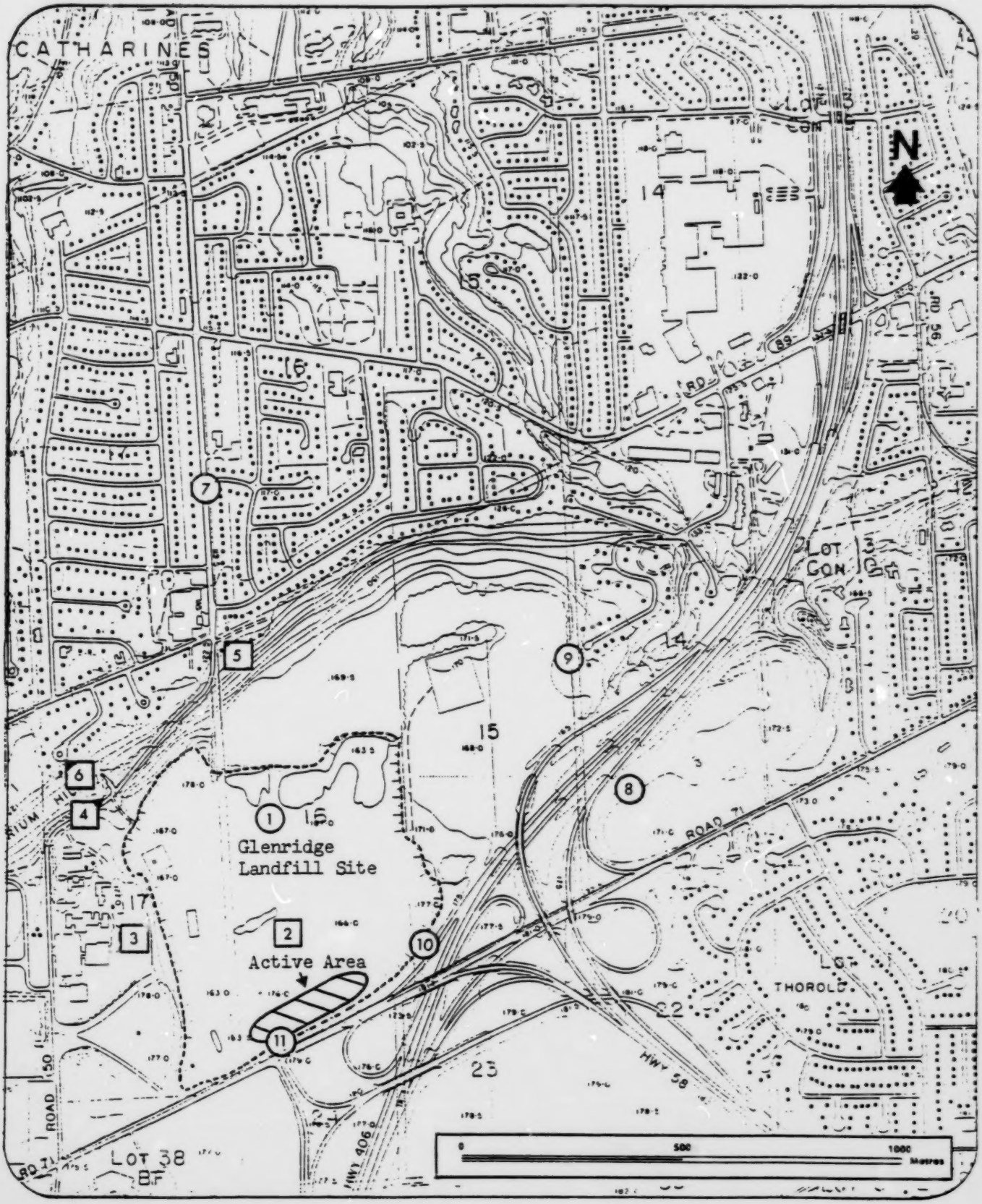
TABLE: 1 (cont'd)

Site Number	Vegetation Examined	Site Location/ Visual Observations
9	mountain ash	Evidence of fungal spot injury.
	cottonwood	Evidence of intercostal fungal spot injury.
10		On highway 406 - immediately north of St. Davids Road - immediately east of Glenridge Landfill site.
	sumac	Evidence of insect chewing injury.
	hawthorn	Evidence of intercostal fungal injury
	elm	Evidence of insect chewing injury.
	wild grape	Evidence of insect and fungal injury. Evidence of senescence.
	dogwood	No visible injury.
	wild cherry	Evidence of insect injury.
	black walnut	Evidence of insect and fungal injury. Evidence of senescence.
11		North side of St. David's Road, immediately east of main entrance to Glenridge Landfill site.
	Russian olive	Evidence of intercostal fungal injury
	green ash	Evidence of intercostal insect stipple and chewing injury.
	amur maple	Recently planted (2-3 years) saplings Evidence of stress or early senescence. Evidence of terminal, marginal and intercostal fungal spot injury.
	currants	Marginal chlorosis due to stress or senescence.

TABLE: 1 (cont'd)

Site Number	Vegetation Examined	Site Location/ Visual Observations
11	pussy willow	Evidence of insect stipple injury. Evidence of senescence.

FIGURE: 1 Locations of Phytotoxicology Vegetation Surveillance Sites



○ - Vegetation Surveillance Site
□ - Vegetation Surveillance Site and MAMU Air Monitoring Location